REMARKS

In view of the above amendment, applicant believes the pending application is in condition for allowance.

Claims 11-14 have been withdrawn by the Examiner.

Claim 19 and 21 are rejected under 35 U.S.C. § 112, first paragraph.

Claim 19 and 21 are also rejected under 35 U.S.C. § 112, second paragraph.

Claim 19 has been amended to clarify the claim by cancelling the limitation concerning the secondary circuit being "entirely closed." This should avoid further rejection under 35 USC 112.

Applicant does not quite understand the Examiner's point regarding the 112 rejections of claim 21. However, the claim has been amended to more clearly state the compression ratio in the range of 1.5 to 3. This limitation finds support in the Specification, on page 15, lines 11-13. Should the Examiner feel that the claim requires further language clarification he is requested to suggest particulars.

Claims 5 and 20 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Griepentrog et al. (GB 2 050 6798) in view of Nathenson et al. (US 4,842,054). Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Griepentrog et al. in view of Nathenson et al. and Squires (US 3,436,909). Claim 16 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Griepentrol et al. in view of Nathenson et al., Squires and Werker et al. (US 4,236,968). Claims 17 and 18 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Griepentrog et al. and Nathenson et al. in view of Naito (US 4,714,593). Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Griepentrog et al. and Nathenson et al. in view of Berchtold et al. (3,218,807). The following discussion will address the prior art arguments.

Claim 5

Griepentrog describes the following features of claim 5: a device for producing electricity from the heat produced by high temperature reactor 1 with an operating temperature above 800°C, with a primary circuit 5 in which helium is circulated, a secondary circuit 7 in which a mixture of helium and nitrogen is circulated, and an intermediate heat exchanger 6. The secondary heat exchange gas drives a gas turbine 8.

Griepentrog does not teach a tertiary water steam circuit, with a steam generator and a steam turbine. It does not teach that the second heat exchange gas has a temperature between 550 and 700°C after passing through the turbine (594°K = 321°C in Griepentrog, see page 3 line 47).

The advantages of the invention over Griepentrog are as follows.

- Better efficiency: a water steam cycle is particularly adapted to "low" temperatures (hottest point below 550°C) and it takes advantage of the very effective phase change condensation. A gas cycle is adapted to high temperatures, e.g., hottest point way above 550°C, coldest point above 500°C. A gas cycle cannot enjoy the benefits of condensation. Starting from a primary circuit at 800°C or more, having a secondary gas circuit and a tertiary water steam circuit permits to have them both operating in their most effective temperature range. In Griepentrog, the single secondary gas circuit does not work in the most adapted temperature range since its coldest point is 20°C. If the core was at an operating temperature below 800°C, it would be advantageous to use two circuits only, a primary gas circuit, and a secondary water steam circuit.

- The gas turbine of the invention has a small expansion ratio of 1.5 to 3 (from 70 bars to 20 or 30 bars). In Griepentrog, the expansion ratio is high, of the order of 10 (from 40 bars to 4.3bars), and the turbine works at a high temperature (900°C). A turbine adapted to a gas containing a large amount of helium, working at said temperature and at said expansion ratio, is very difficult to design and does not exist presently in the inventor's knowledge.

- The same is true for the compressor of the secondary circuit. Helium is difficult to compress. A compression ratio of 20 or above can be easily achieved with air. It is difficult to achieve with a gas containing a large amount of helium. In the invention, the compression ratio is low (1.5 to 3). In Griepentrog, the compression ratio is high (of the order or 10).

The Examiner states that Nathenson describes a water steam tertiary circuit, with a steam generator 24 and a steam turbine 26. According to him, the motivation to include the teachings of Nathenson into Griepentrog are (page 8 of the Office Action):

a) improving electrical efficiency by decreasing temperature,

b) less demanding mechanical design parameter at reduced operating temperature,

c) transformation of usable enegy into its most conventional form of steam thus being able to drive convention generators of electricity.

On page 30 of the Action, the Examiner explains that, given an overall temperature difference (hottest point-coldest point in the system) adding a third circuit allows to have gentler drop in temperature between each pair of circuit, thus a higher efficiency.

Applicant replies a follows:

Nathenson is not a high temperature reactor, since its operating temperature is not above 800°C (500°C, column 6 line 2). It is not an analogous art (see action page 7). Griepentrog is indeed a high temperature, helium cooled reactor, as the invention is. Nathenson is a fast breeder, sodium cooled, and is not high temperature.

In Nathenson, a secondary circuit is foreseen between the primary sodium circuit and the tertiary water steam circuit for safety reasons. Sodium is highly reactive with water. One does not want to take the risk of a leak of water directly into the primary sodium passing through the core. In Nathenson, in case of a leak, the water enters the secondary sodium circuit, which does not pass through the core. The operating temperature of the core of Nathenson (500°C) is such

that it would be adapted to have a direct exchange primary circuit/water steam circuit, since the water steam circuit would operrate at a proper temperature range (see above: below 550°C).

Neither Griepentrog nor Nathenson teaches that the secondary gas enters the steam generator at a temperature between 550°C and 700°C.

Nathenson does not teach that decreasing the temperature improves the efficiency of the heat exchanges system as a whole. The text cited by the Examiner (col. 2 lines 62-64) indicates that decreasing the temperature helps improve the efficiency of the flow coupler (electromagnetic pump) of Nathenson. Griepentrog does not have a flow coupler, and the man skilled in the art would therefore not consider the teaching of Nathenson for improving the efficiency of the heat exchange system of Griepentrog as a whole.

Regarding motivations a) and b), it is contradictory to say that the temperature will be reduced and that there will be a gentler drop in temperature between each pair of circuit. Starting from a given hottest point (heat exchanger between the primary and secondary gases), if the drop of temperature is gentler, the temperatures of the secondary circuit will be higher.

Regarding the motivation that having a gentler drop in temperature between each pair of circuit permits a higher efficiency, this is true for a Carnot cycle. However, the circuits here are not Canot cycles. The Examiner does not clearly demonstrate how to achieve increased efficiency when adding a tertiary water steam circuit to Griepentrog. There are a number of questions to solve, especially when considering the temperature range and the type of gas to be used in the circuits. The Examiner did not demonstrate that what is true for an ideal Carnoet cyctle is true for a non ideal gas cycle and a non ideal water steam cycle.

In real life, devices to generate electricity from a nuclear heat source have one or two cycles. Boiling water nuclear reactors have only one cycle. Pressurized water nuclear reactors have two cycles. If the logic of the Examiner were true, devices to produce electricity would all have a great number of cycles, possibly 4, 5 or even 10. They never do. When building a real device to produce electricity, engineers take into account the cost of investment and the cost of

operation and maintenance, all of which increase with the number of cycles. The man skilled in the art, to decide about the number of circuits, considers what is actually done in the art of nuclear engineering and not ideal Carnot cycles.

No lesson can be derived from Nathenson regarding the efficiency of a device with two cycles, each having a turbine producing electricity. In Nathenson, the secondary circuit does not have a turbine. The secondary circuit is included only for safety reasons. The overall efficiency of the device of Nathenson would actually be higher if the device had only the primary sodium circuit and the tertiary water and steam circuit, with no intermediate sodium circuit. The teachings that can be derived from Nathenson regarding the overall efficiency of a device with three circuits are exactly contrary to what the Examiner tries to demonstrate.

Regarding motivation to combine c), the man skilled in the art who wants to recover usable energy in the secondary fluid of Griepentrog would not choose to produce steam and drive a steam turbine. He would expect that the investment and maintenance cost of such a tertiary water and steam circuit with its steam turbine is heavy. His first choice would be to directly transfer available heat of the secondary fluid by mean of a heat exchanger. The associated costs would be much lower. A direct heat transfer is indeed implemented in Grienptrog, by mean of exchanger 12. Furthermore, no usable energy remains in the secondary fluid in Griepentrog when said fluid exits heat exchanger 12 (see page 3, line 49, 50: "...the utilizable energy liberated is tranferred to the compressed gas flowing through the high pressure side.") The gas is only at 20°C (290°K) after cooler 13, and no energy can be recovered any more. Another possibility considered by the man skilled in the art is heat recovery towards other fluids of the industrial plant. The cost of a tertiary circuit with a steam turbine would certainly prevent the main skilled in the art to choose such a solution to optimize the economic efficiency of the device.

Again, if recovery of energy in the form of steam was sufficient motivation to include a water steam circuit in an industrial facility, all industrial facilities would have steam turbines. This is not the case.

Claim 15

Squires does not teach the limitation of claim 15 according to which each of the first and second heat exchanger (13a, 13b) have a primary portion supplied with second heat exchange gas from

Squires does not teach the limitation of claim 15 according to which each of the first and second heat exchanger (13a, 13b) have a primary portion supplied with second heat exchange gas from **bypasses** of the secondary circuit (9).

In Squires, heat exchangers 14, 15 and 16 are in series on the same lines of the secondary circuit. They are not fed by respective bypasses.

The Examiner indicates that the device of Squires is adapted to nuclear heat. Squires actually does not teach that. It is indicated to col 5 lines 16 to 23 that a nuclear reactor can supply low temperature heat needed to raise steam, and that a fossil fuel is necessary to superheat the steam for the cycle of the invention. The cycle of Squires requires both a nuclear reactor and a fossil power plant. It is not an analogous art to Griepentrog and Nathenson.

The Examiner indicates that a motivation to combine Squires with Griepentrog and Nathenson is that Squires teaches "increased efficiency and unusual economy". However, said efficiency and economy are associated in Squires to feature different from those of claim 15 (see col 4, lines 3 to 21).

Claim 16

Werker does not teach the feature of claim 16 according to which a counter-current exchanger (16) has a secondary potion receiving at the inlet water originating from the condenser and at the outlet supplying heated water to the steam generater and a primary portion in which the second heat exchange gas circulates. In Werker, condensed water of the secondary circuit circulates on one side of exchanger 15, and high pressure steam coming from the secondary circuit at the exit of turbine 7 (via line 31) circulates on the other side of exchanger 15 (see

figure) to pre heat condensed water before it enters the steam generator 2. The water before entering the steam generator is not heated by the same fluid as in claim 16.

It is not obvious to feed preheated water rather than cold water to a steam generator for efficiency. It depends on the overall heat management of the circuits. In some instances, it may be more efficient to feed cold water.

Regarding the rejection of section 16, applicant provides the following remarks.

Berchtold does not describe that the heat is generated by a high temperature nuclear reactor (col 2 lines 57 to 62). It is not clear in Berchtold if the circuit described is a primary, secondary or tertiary circuit. The compressor with a compression ratio of 2.5 in Berchtold is not necessarily in a secondary circuit.

In any case, Berchtold does not describe a device for producing electricity including three circuits, with a secondary gas circuit including a turbine and a compressor, and a tertiary water and steam circuit with at least a steam turbine. The man skilled in the art knows that the compression ratio in a given cycle depends on the overall design of the device, and especially from the temperature and pressure profile along each cycle. Nothing indicates that the compression ration of 2.5 of a facility having a single circuit (such as Berchtold) can be successfully used in a facility having three circuits (such as Griepentrog + Nathenson).

On page 8 of the Office Action the Examiner lists a)-d) as functional statements in the claims. The claims have been reviewed and clarified to avoid intended use and rather positively recite limitations that affect the clarity of the claim when considered as a whole.

In summary, the rejections have been responded to and the prior art discussed so as to make evident that all the claims remaining in this application are patentable.

In view of the above, consideration and allowance are, therefore, respectfully solicited.

In the event the Examiner believes an interview might serve to advance the prosecution of this application in any way, the undersigned attorney is available at the telephone number noted below.

The Director is hereby authorized to charge any fees, or credit any overpayment, associated with this communication, including any extension fees, to CBLH Deposit Account No. 22-0185, under Order No. 20513-00607-US from which the undersigned is authorized to draw.

Dated: November 5, 2008

Respectfully submitted,

Electronic signature: /Morris Liss/
Morris Liss
Registration No.: 24,510
CONNOLLY BOVE LODGE & HUTZ LLP
1875 Eye Street, NW
Suite 1100
Washington, DC 20006
(202) 331-7111
(202) 293-6229 (Fax)
Attorney for Applicant